

Risk, negotiation and argumentation—a decision support system based approach

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There has been very little published research on building legal decision support systems to perform risk assessment. Yet one of the principal goals of the law is to reduce risk through the avoidance of litigation. This paper discusses ongoing research on how legal decision support systems can support risk reduction and negotiation. Toulmin's theory of argumentation is proposed as one technique for building legal decision support systems.

Keywords: decision support systems; risk; negotiation; argumentation.

1. Introduction

McBurney & Parsons (2002) includes an excellent coverage of risk assessment, but there is very little application of their work to the domain of law. Whilst there has been extensive research on law and probability, as well as on legal decision support systems, there is a scarcity of reported research on law and risk.

Nevertheless, most legal professionals regularly use risk analysis when preparing and indeed avoiding litigation. To avoid risk, legal professionals conduct negotiations with their opponents. In this paper we report on research on law, information technology, negotiation and risk.

2. Probability, risk and argumentation

Whilst probability and risk are commonly inter-related (as also is uncertainty), they are used in quite different ways in the legal domain. Probability and risk have significant differences in how they are utilized in civil law and criminal law (the findings in this paper are related primarily to Common Law countries). In criminal law, the onus of proof is beyond reasonable doubt. To quote Black (1990), this means that the evidence must clearly, precisely and indubitably convict the accused. In criminal law, statistics has been used to analyse evidence (see for example Aitken (1995) and Schum (1994)). Areas investigated include DNA testing, fingerprints, footwear and ballistics. Kadane & Schum (1996) used probability and Wigmore's diagrams of evidence to analyse the trial of the American anarchists Sacco and Vanzetti.

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Zeleznikow & Stranieri (1998) stress that software can help with legal interpretation, but not make decisions about facts. They noted that only a human can make decisions with regard to facts and that humans will disregard information they find inconceivable.

They reached this conclusion when evaluating the performance of the Split-Up system (See below for a description of the Split-Up system) compared to the opinions of a group of ten expert family lawyers. The only disagreement within the group and between the group and the Split-Up system came in a case where both parties had performed little work around the house—the couple had relied on domestic help for maintenance, domestic chores and childcare.¹ The Split-Up system claimed the husband contributed more financially than the wife, and that they both contributed equally in non-financial terms. It also suggested the wife's resources for the future were much less than the husband's resources. It thus awarded the husband 55% of the marital property. Examining the reasoning of those lawyers who disagreed with the Split-Up system, it appears that many of them failed to accept the data in the case as valid. They could not believe that in a marriage of thirty years, where the husband was heavily occupied in his medical practice, the wife would not have contributed much more, in non-financial terms, to the family than did the husband. This allowed them to conclude that the husband and wife contributed equally during the marriage.

In building legal decision support systems, it is thus better to focus upon interpreting the law rather than making decisions upon facts. Because of the *beyond reasonable doubt* onus in criminal law, very few decision support systems have been built in criminal law. The exceptions are in the domain of sentencing (see Schild (1998) and Zeleznikow (2000) for a discussion of discretion and sentencing information systems). The burden of proof in civil law is *on the balance of probabilities*. Hence it is easier to build decision support systems in civil law domains.

Judicial decision-making first involves the determination of the facts of a case. The second step then involves applying the law to the given fact situation. Legal decision support systems have primarily been used in civil law domains to provide an interpretation of the law.

McBurney & Parsons (2002) devote a considerable amount of effort in their paper to discussing argumentation and computational dialectics. They quote Walton & Krabbe (1995) as identifying several types of primary dialogue: information seeking dialogues, inquiries, persuasion dialogues, negotiations, deliberations and eristic (strife-driven) dialogues. All these types of dialogues regularly occur in law. This paper focuses upon persuasion dialogues and negotiations.

Argumentation has been used in knowledge engineering in two distinct ways: with a focus on the use of argumentation to structure knowledge (i.e. non-dialectical emphasis) and with a focus on the use of argumentation to model discourse (i.e. dialectical emphasis). Dialectical approaches typically automate the construction of an argument and counterarguments, normally with the use of a non-monotonic logic, where operators are

¹ This case involved Couple A who had been married 30 years with three independent sons aged 28, 25 and 22. Both ex-partners were 60 years old. Mr A worked throughout the marriage being a partner in a pathology practice. He currently earns \$250 000 per annum. His wife had not worked during the marriage. Both parties performed little around the house—they relied on domestic help for maintenance, domestic chores and child care. They own a house worth \$800 000, have \$500 000 in shares and the husband is the half-owner of a medical practice valued at \$1 000 000. They each own cars worth \$50 000. Both parties are in good health. Neither party brought any significant finances into the marriage.

defined to implement discursive primitives such as *attack*, *rebut*, or *accept*. Carbogim *et al.* (2000) present a comprehensive survey of defeasible argumentation.

Vreeswijk (1993), Prakken (1993), Prakken & Sartor (1996) and Gordon (1994) have proposed dialectical models in the legal domain. In applications of argumentation to model dialectical reasoning, argumentation is used specifically to model discourse and only indirectly used to structure knowledge. The concepts of conflict and of argument preferences map directly onto a discursive situation where participants are engaged in dispute. In contrast, many uses of argumentation for knowledge engineering application do not model discourse. This corresponds more closely to a non-dialectical perspective.

A non-dialectical representation facilitated the organization of complex legal knowledge for information retrieval by Dick (1987). She illustrates how relevant cases for an information retrieval query can be retrieved despite sharing no surface features, if the arguments used in case judgements are represented as Toulmin structures. Marshall (1989) and Loui *et al.* (1997) have built hypertext based computer implementations that draw on knowledge organized as Toulmin arguments. Hypertext links connect an argument's assertions with the warrants, backing and data of the same argument and also link the data of one argument with the assertion of other arguments. In this way, complex reasoning can be represented succinctly enabling convenient search and retrieval of relevant information.

The analysis of argument advanced by Toulmin (1958) does not distinguish dialectical argumentation from non-dialectical argumentation. By illustrating that logic can be viewed as a kind of generalized jurisprudence rather than as a science, Toulmin (1958) advanced a structure of rhetoric that captures the layout of arguments. Jurisprudence focuses attention on procedures by which legal claims are advanced and attacked. Toulmin (1958) sought to identify procedures by which any claim is advanced. He identified a layout of arguments that was constant, regardless of the content of the argument.

He concluded that most arguments, regardless of the domain, have a structure that consists of six basic invariants: claim, data, modality, rebuttal, warrant and backing. Every argument makes a claim based on some data. The argument in Fig. 1 is drawn from reasoning regarding refugee status according to the 1951 United Nations Convention relating to the Status of Refugees (as amended by the 1967 United Nations Protocol relating to the Status of Refugees), and relevant High Court of Australia rulings. The claim of the argument in Fig. 1 is the statement that Reff has a well-founded fear of persecution. This claim is made on the basis of two data items, that Reff has a real chance of persecution and that relocation within Reff's country of origin is not appropriate. A mechanism is required to act as a justification for why the claim follows from data. This justification is known as the warrant which is, in Fig. 1, the statement that *The test for well-founded fear is real chance of persecution unless relocation affords protection*. The backing provides authority for the warrant and in a legal argument is typically a reference to a statute or a precedent case. The rebuttal component specifies an exception or condition that obviates the claim. Reff may well have a real chance of persecution and relocation is unlikely. However, the claim that his fear is well founded does not hold if Reff's persecution is due to criminal activities.

Matthijssen (1999) provides a further example of benefits that arise from the use of the Toulmin structure. He represented user tasks as Toulmin arguments and associated a list of keywords to the structure. These keywords were used as information retrieval queries into a range of databases. Results indicate considerable advantages in precision and recall of

One of the major benefits of decision support systems that advise upon risk assessment, is that they help avoid litigation. Ross (1980) states *the principal institution of the law is not trial; it is settlement out of court*. To support this argument, Williams (1983) notes that whilst the figures may vary in different jurisdictions, of all the cases listed before the courts only about 5% of the cases are ever heard by the court and only 1% of the cases result in judicial decision-making. He quotes the 1980 Annual Report of the Director-Administrative Office of the United States of America Courts, Washington, DC (1980) at pages A-28 and A-20 which states that the average percentage of cases reaching trial verdict is 6.5%. The average for districts varies from a low of 2.0% to a high of 16.1%. By circuits, the differences are less extreme, ranging from a low of 4.0% in the District of Columbia Circuit to a high of 8.4% in the Eighth Circuit.

Further, many disagreements are never even listed before courts. Ross (1980) claims that a major study of personal injury/automobile insurance cases in the United States shows that, of claimants represented by attorneys who obtained some compensation, 72% filed suit, 6.5% started trial and 2% reached a verdict.³ Obviously these figures will vary depending on the jurisdiction and type of actions, however, what does not vary is that negotiated settlements account for the vast majority of all legally binding decisions.

Katsh & Rifkin (2001) state that compared to litigation, Alternative Dispute Resolution has the following advantages:

- (a) lower cost;
- (b) greater speed;
- (c) more flexibility in outcomes;
- (d) less adversarial;
- (e) more informal;
- (f) solution rather than blame-oriented;
- (g) private.

To avoid the risks of extra costs and an unfavourable outcome, disputants often prefer to negotiate rather than litigate. Whilst investigating how disputants evaluate the risks of litigation researchers are faced with a basic hurdle—outcomes are often, indeed usually, kept secret. If the case is litigated, it could be used as a precedent for future cases, which may be a disincentive for one or more of the litigants (Goldring, 1976). Publicity of cases and the norms resulting from cases makes the public aware of the changing attitudes towards legal issues.⁴ The adjudication decision not only leads to the resolution of the dispute between the parties, but it also provides norms for changing community standards (Eisenberg, 1976). This latter facet is lost in negotiated settlements.

The secrecy behind negotiated settlements is one of the reasons for the paucity of published material on legal decision support systems dealing with risk. WIRE IQ (Wire Intelligent Quantum) is an Internet-delivered decision support system which allows lawyers, insurers and re-insurers access to up-to-the-minute quantitative analysis of current claims settlement values for a wide range of personal injuries (Douglas & Toulson, 1999).

³ Automobile Personal Injury Claims, US Department of Transportation, Automobile Insurance and Compensation Study, 1970.

⁴ In common law countries, changing community values towards issues such as abortion, euthanasia and rape within marriage have been enacted in the legal system through landmark precedents, rather than parliamentary legislation.

Douglas & Toulson (1999) state that analysis and price discovery of tort in un-settled personal injury claims has been conducted using rule-based systems. In such systems, the details of the claim (injury type, claimant's age, sex, earnings, etc.) are entered into the system. The system then applies predefined rules to determine the settlement value of the claim.

WIRE IQ uses a database with thousands of records of settled claims and court wards for a range of personal injury claims. It then provides the following analysis services based on the data: trend analysis, comparative analysis, precedent search and forecasts. The forecasts are performed using neural networks.

JNANA (<http://www.jnana.com>) was founded in 1995 as Counselware, with the aim of building decision support systems for lawyers. The company very quickly realized that there was a large commercial need for decision support systems that advise upon risk assessment. Such systems are not made available to the public. JNANA currently focuses upon building a software platform to enable advice to be deployed over the Internet and Intranet. JNANA is now being used broadly in many industries, such as financial services, health care, customer relationship management, legal, and regulatory compliance.

4. Knowledge discovery from databases and negotiation

A neural network receives its name from the fact that it resembles a nervous system in the brain. It consists of many self-adjusting processing elements cooperating in a densely interconnected network. Each processing element generates a single output signal that is transmitted to the other processing elements. The output signal of a processing element depends on the inputs to the processing element. Each input is gated by a weighting factor that determines the amount of influence that the input will have on the output. The strength of the weighting factors is adjusted autonomously by the processing element as data is processed. WIRE IQ uses neural networks to learn weights.

In dealing with the distribution of matrimonial property following divorce in Australia, Stranieri *et al.* (1999) determined that the task of determining what property a Family Court of Australia judge may distribute was determined to be rule-based. The section of the Act dealing with the percentage of the matrimonial property each partner receives is highly discretionary. This is because the Family Law Act (1975) lists a number of factors to be considered for a percentage split determination yet provides no guidance on the relative significance of each factor or on how they are to be combined. Ascertaining knowledge about how a judge weighs and combines factors is difficult, in that a guessed numerical weight is unlikely to represent the actual weight of the factor in the context of a large number of interdependent factors.

Fayyad *et al.* (1996) define knowledge discovery in databases (KDD) as the non-trivial process of identifying valid, novel, potentially useful understandable patterns in data. Because most KDD systems use some form of statistical algorithm to discover knowledge, data mining and knowledge discovery systems fail to provide adequate explanation—an essential element of any legal decision support system. In law and the social sciences an explanation of the system's reasoning can be as important as the decision reached.

Neural networks have rarely been used in the legal domain because explanations are difficult to generate and assembling training sets of sufficient size and coverage is similarly difficult. Stranieri *et al.* (1999)'s approach was to claim that connectionism can

be useful in law if a series of smaller, interconnected networks are used instead of one larger network and if explanations are generated independently of the process used to infer a conclusion. To provide explanation independently of the conclusion inferred they used Toulmin Argument Structures. Factors that were relevant in determining a percentage split in the resulting Split-Up system were elicited from experts and from statutes to form a hierarchy of relevant factors. The argument-based framework used in Split-Up is not limited to rules and neural networks but can easily accommodate other forms of inferencing including fuzzy logic, inferential statistics and non-monotonic logic.

In the current version of Split-Up only rules and neural networks are used. Previously, Zeleznikow *et al.* (1996) considered the use of rule induction,⁵ whilst Stranieri *et al.* (2000) considered the use of association rules⁶ for discovering knowledge about the distribution of marital property.

The decision about which inferencing technique to use is determined by a jurisprudential theory (Stranieri *et al.*, 1999). This theory focuses upon the concepts of open texture and boundedness.

Open-textured predicates contain questions that cannot be structured in the form of production rules or logical propositions and which require some legal knowledge on the part of the user in order to answer. Rule- and logic-based systems handle open texture poorly, and generally rely on the user to resolve the open-textured predicate without assistance.

Zeleznikow *et al.* (1994) and Zeleznikow & Hunter (1994) state that despite their qualms about using rule-based systems for dealing with open texture, deduction is a powerful and useful form of reasoning. It has particular relevance in areas which are based on legislation and which have little case law, customary law or doctrines. Examples of legal domains which are amenable to being modelled using rule-based systems include civil law jurisdictions where case law provides only some assistance in interpreting the code, or, in common law countries, rarely litigated statutes, new statutes and codifications of the case law.

Stranieri *et al.* (1999) classifies legal tasks by describing appropriate modelling techniques for various categories of legal problems. A domain is bounded if the problem space can be specified in advance, regardless of the final definitional interpretation of the terms in the problem space. A problem space is unbounded if one cannot specify in advance which terms lie within the problem space.

The dimension open-textured—well-defined refers to the modeller's belief as to the extent to which a task is open-textured. Although every possible extension for an open-textured concept cannot be predicted, we believe that it is possible to estimate the extent to which the known extensions represent all possibilities. Practitioners seem to estimate the degree of open texture of a statute in order to offer a prediction. For example, the concept

⁵ A (crisp) rule is of the form IF <condition(s)> THEN <action>. An example of a rule is *if you drink and drive then you lose your licence*. A rule induction system is given examples of a problem where the outcome is known. When it has been given several examples, the rule induction system can create rules that are true from the example cases. The rules can then be used to assess other cases where the outcome is not known.

⁶ An association rule is a rule that is not crisp. Non-crisp rules have both an associated support and an associated confidence. In the drink driving example, the support of the rule indicates what percentage of all drivers tested have been drinking, whilst the confidence of the rule indicates what percentage of drivers who have been drinking and driving lose their licence. A crisp rule has confidence 100%.

of *liability to pay child support* under the Child Support Act 1988⁷ is far less subject to new uses than the concept of *paramount interests of the child*, which is the sole criterion in determining the custody of, and access to, children. There are numerous rule-based child support calculators available to legal practitioners⁸.

The bounded–unbounded dimension refers to the extent to which an expert believes that all terms relevant for the performance of a task are explicitly known. Because Stranieri *et al.* (1999) is confident about what factors are involved in both common pool determination and the percentage split determination, both tasks are bounded. Since the task of deciding what is marital property is not open-textured, Stranieri *et al.* (1999) decided they could use a rule-based system to model this task. However, the task of distributing marital property is open-textured (but bounded). Thus Stranieri *et al.* (1999) used knowledge discovery from database techniques to reason in this domain.

The task of predicting custody arrangements is quite unbounded since Stranieri *et al.* (1999) did not believe all, or even most, factors relevant for this determination are known. Each judge has her/his own set of family values, which cannot be automated.

5. Building negotiation support systems

Litigation can be damaging to both parties in a dispute. It is at best a zero-sum game; in that what one party wins the other loses.⁹ Mediation can strive to reduce hostility between the parties, to fashion an agreement about tasks each party is willing to assume and to reach agreement on methods for ensuring certain tasks have been carried out. It can lead to a win–win result.¹⁰

Thus the major use of legal decision support systems in risk assessment has been to support negotiation. Fundamental to the concept of principled negotiation (Fisher & Ury, 1981) is the notion of *Know your best alternative to a negotiated agreement (BATNA)*. The reason you negotiate with someone is to produce better results than would otherwise occur. If you are unaware of what results you could obtain if the negotiations are unsuccessful, you run the risk of (1) entering into an agreement that you would be better off rejecting; OR (2) rejecting an agreement you would be better off entering into.

Split-Up can be used to determine one's BATNA for a negotiation. It first shows both litigants what they would be expected to be awarded by a court if their relative claims were accepted. It gives them relevant advice as to what would happen if some or all of their claims were rejected. They are able to have dialogues with the Split-Up system about hypothetical situations, which would support their negotiation. Both litigants then have clear ideas about the strengths and weakness of their claims.

Jennings *et al.* (2001) developed a generic framework for classifying and viewing

⁷ The Child Support Act 1988 specifies the financial liability of a non-custodial parent for his/her children. The formula is a function of both parents' incomes, the number of children and other dependants both parents have and the amount of time each child spends with each parent. Whilst the Child Support Act 1999 changed the formulae for child support, the basic principles of the Child Support Act 1988 have remained intact.

⁸ See for example the Child Support calculators provided by the Child Support Agency of Australia. These can be found at <http://www.csa.gov.au/calc/Calculator.html>

⁹ It is actually worse than a zero-sum game and indeed can often lead to a lose-lose result. This is because of the large legal fees arising from litigation.

¹⁰ For example if both parties value the list of items in dispute, it is not uncommon (as long as they do not value the items in an identical manner) for each party to receive 70% of their requested points.

automated negotiations. This framework was then used to analyse the three main methods of approach that have been adopted to automated negotiation, namely:

- (1) game theory;
- (2) heuristics;
- (3) argumentation-based approaches.

Bellucci & Zeleznikow (2001) have used all three techniques in building negotiation support systems. They have focused upon Australian Family Law. In most legal conflicts, once a settlement is reached the parties to the settlement are not required to have an ongoing relationship. This is not the case in Australian Family Law. Family Law (Ingleby, 1993) varies from other legal domains in that in general:

- (1) There are no winners or losers—save for exceptional circumstances, following a divorce both parents receive a portion of the property and have defined access to any children.
- (2) Parties to a family law case often need to communicate after the litigation has concluded. Hence the Family Court encourages negotiation rather than litigation.

Split-Up uses an argumentation-based approach to advise disputants upon their BATNA. Game-theoretic techniques and decision theory were the basis for Adjusted Winner (Bellucci & Zeleznikow, 1998), which implemented the procedure of Brams & Taylor (1996). Adjusted Winner is a point allocation procedure that distributes items or issues to people on the premise of whoever values the item or issue more. The two players are required to explicitly indicate how much they value each of the different issues by distributing 100 points across the range of issues in dispute. The Adjusted Winner paradigm is a fair and equitable procedure. At the end of allocation of assets, each party accrues the same number of points.

Family_Winner (Bellucci & Zeleznikow, 2001) uses both game theory and heuristics. It supports the process of negotiation by introducing importance values to indicate the degree to which each party desires to be awarded the issue being considered. The system uses this information to form trade-off rules. The trade-off rules are used to allocate issues according to the logrolling strategy. The system makes this analysis by transforming user input into trade-off values, used directly on trade-off maps, which show the effect of an issue's allocation on all unallocated issues.

Users of the Family_Winner system enter information such as the issues disputed, indications of their importance to the respective parties and how the issues relate to each other. An analysis of the aforementioned information is compiled, which is then translated into graphical trade-off maps. The maps illustrate the relevant issues, their importance to each party and trade-off capabilities of each issue. The system takes into account the dynamics of negotiation by representing the relations that exist between issues. Maps are developed by the system to show a negotiator's preferences and relation strengths between issues. It is from these maps that trade-offs and compromises can be enacted, resulting in changes to the initial values placed on issues.

The user is asked if the issue can be resolved in its current form. If so, the system then proceeds to allocate the issue as desired by the parties. Otherwise, the user is asked to decompose an issue chosen by the system as the least contentious. Essentially, the issue on which there is the least disagreement (one party requires it greatly whilst the other party

expresses little interest in the issue) is chosen to be the issue first considered. Users are asked to enter sub-issues. As issues are decomposed, they are stored in a decomposition hierarchy, with all links intact. This structure has been put in place to recognize there may be sub-issues within issues on which agreement can be attained. It is important to note that the greater the number of issues in dispute, the easier it may be to allocate issues, as the possibility of trade-offs increases. This may seem counterintuitive, but if only one issue needs to be resolved, then suggesting trade-offs is not possible.

This process of decomposition continues through the one issue, until the users decide the current level is the lowest decomposition possible. At this point, the system calculates which issue to allocate to which party, then removes this issue from the parties' respective trade-off maps, and makes appropriate numerical adjustments to remaining issues linked to the issue just allocated. The resulting trade-off maps are displayed to the users, so they can see what trade-offs are made in the allocation of issues. When all issues are allocated at the one level, then decomposition of issues continues, re-commencing from the top level in a sequential manner.

The algorithms implemented in the system support the process of negotiation by introducing importance values to indicate the degree to which each party desires to be awarded each issue. It is assumed that the importance value of an issue is directly related to how much the disputant wants the issue to be awarded to her. The system uses this information to form trade-off rules. Systems such as Family_Winner are offer far more negotiation support than decision support systems that advise upon BATNAs.

6. Conclusion

This paper has considered how law, decision support systems and risk are inter-related. Because of the desire of most companies to avoid risk and uncertainty, the principal institution of the law is not trial; it is settlement out of court. Hence the paper has examined how decision support systems and negotiation support systems can support alternative dispute resolution. Techniques used include argumentation, game theory and heuristics.

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